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METHODS AND SOFTWARE FOR HALLUCINATING FACIAL FEATURES BY PRIORITIZING RECONSTRUCTION ERRORS

RELATED APPLICATION DATA

This application claims the benefit of priority of U.S. Provisional Patent Application Ser. No. 61/998,043, filed on Jun. 17, 2014, and titled "Methods for facial image matching," which is incorporated by reference herein in its entirety.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

This invention was made with government support under grant 2013-IJ-CX-K005 awarded by the National Institute of Justice. The government has certain rights in the invention.

FIELD OF THE INVENTION

The present disclosure generally relates to the field of computer graphics processing. In particular, the present disclosure is directed to methods and software for hallucinating facial features by prioritizing reconstruction errors.

BACKGROUND OF THE INVENTION

Over the past few decades, biometric identification and verification using facial features has gained prominence both in traditional video surveillance/access control systems and in hand-held devices for daily use. Most of these approaches work under the implicit assumption that the entire face of a subject can be captured with decent quality. However, there are many real-world scenarios where only a partial face is captured or instances when only the eye region of a face is visible, especially for the cases of uncooperative and non-cooperative subjects. Conventional commercial matchers and law enforcement agencies who rely on such matchers to perform face matching for identification will typically run into problems in the case where only the periocular region is available. This is due to the fact that commercial matching algorithms are developed using the entire human face and typically simply cannot deal with partial faces.

SUMMARY OF THE INVENTION

Aspects of the present disclosure focus on deducing information from the periocular region of the face, which is rich in textural information (e.g., eyebrows, eye folds, eyelid contours, etc.) that can all vary in shape, size and color. Biologically and genetically speaking, more complex structure means more "coding processing" going on during fetal development, and therefore more proteins and genes involved in the determination of appearance. In view of this, the periocular region may be the most important facial area for distinguishing people. Robust periocular based biometric recognition can lead to very useful applications, such as identifying criminals captured in photos wearing masks where only the eye region is exposed or in videos containing many occluded faces with un-occluded eye regions, among others.

A novel approach is proposed herein that can be used to hallucinate a full face as a function of the periocular region of a subject with high fidelity devoted to the known periocular region. The approach is based on the modification of

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a problem formulated for sparsely coded dictionary learning. In some embodiments, methods of the present disclosure focus on reconstructing the periocular region faithfully while providing a good visual approximation of facial features that can be used for further processing. In hallucinating the rest of the face, these methods capitalize on weak correlations between periocular features and other facial features. These correlations might exist due to specific gender, ethnicity or age, which are soft-biometric in nature. Various approaches described herein find these relations in an unsupervised manner from a large corpus of frontal training images. Throughout the disclosure, the term "hallucination" and "reconstruction" are used interchangeably.

In one implementation, aspects of the disclosure are directed to a method of hallucinating facial features by prioritizing reconstruction errors. Such a method may include receiving an image of a first region of a first face, the first region containing one or more first facial features; training a machine-learning algorithm using a set of images each containing a region of a face of an individual corresponding to the first region and a region of the face of the individual not corresponding to the first region to produce machine-learning data or receiving machine-learning data corresponding to a previous implementation of such training; and hallucinating one or more second facial features of the first face, the second facial features differing from the one or more first facial features, as a function of the machine-learning data by prioritizing reconstruction errors for hallucinating the one or more second facial features such that reconstruction error for the one or more first facial features is minimized with a higher priority than reconstruction error for hallucinating the one or more second facial features.

In another implementation, aspects of the disclosure are directed to a machine-readable storage medium containing machine-executable instructions for performing a method of hallucinating facial features by prioritizing reconstruction errors. Such machine executable instructions may include a first set of machine-executable instructions for receiving an image of a first region of a first face, the first region containing one or more first facial features; a second set of machine-executable instructions for training a machine-learning algorithm using a set of images each containing a region of a face of an individual corresponding to the first region and a region of the face of the individual not corresponding to the first region to produce machine-learning data or receiving machine-learning data corresponding to a previous implementation of such training; and a third set of machine-executable instructions for hallucinating one or more second facial features of the first face, the second facial features differing from the one or more first facial features, as a function of the machine-learning data by prioritizing reconstruction errors for hallucinating the one or more second facial features such that reconstruction error for the one or more first facial features is minimized with a higher priority than reconstruction error for hallucinating the one or more second facial features.

These and other aspects and features of non-limiting embodiments of the present invention will become apparent to those skilled in the art upon review of the following description of specific non-limiting embodiments of the invention in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

For the purpose of illustrating the invention, the drawings show aspects of one or more embodiments of the invention.